

PV is On — When the Power is Out

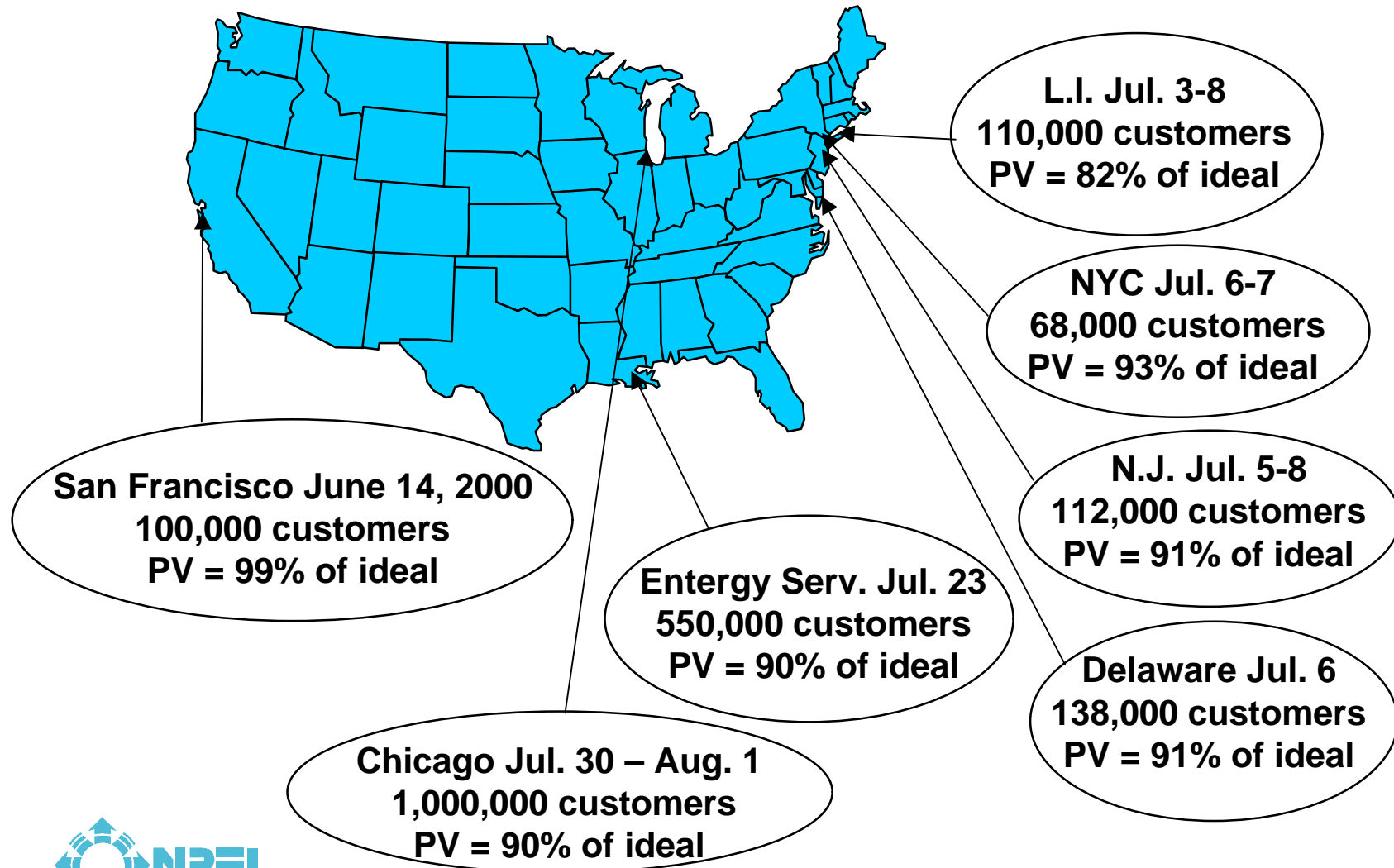
**National Association of Regulatory Utility Commissioners
Committee on Energy Resources and the Environment
2000 Annual Convention**

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San Diego, CA
November 12, 2000



Power Outages

PV Availability---as % of Ideal Output



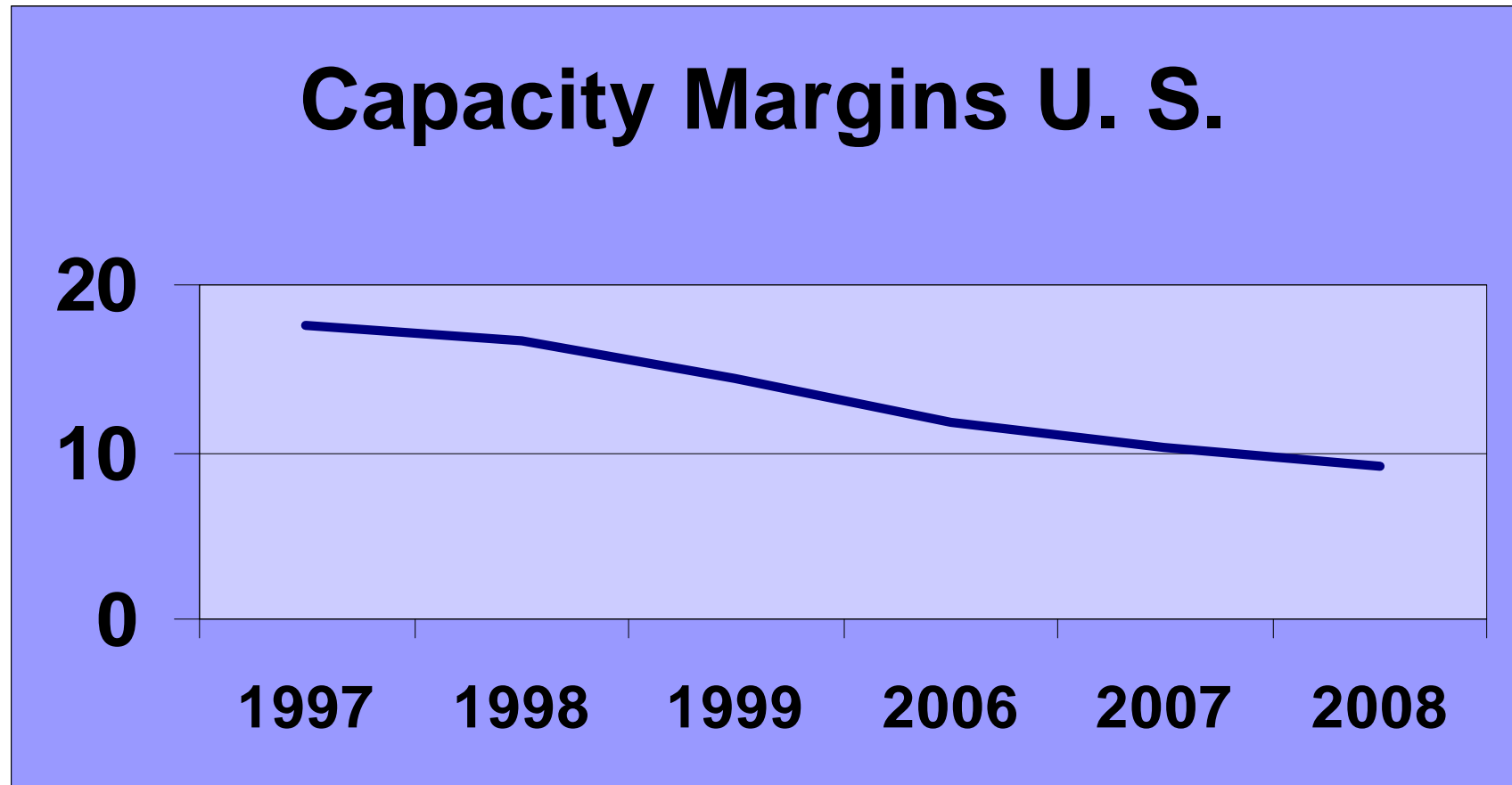
The Customer's Choice??

24_{hours} **7**_{days}

99.9	8hours 46 minutes
99.99	53 minutes
99.999	5 minutes
99.9999	32 seconds
99.99999	3 seconds



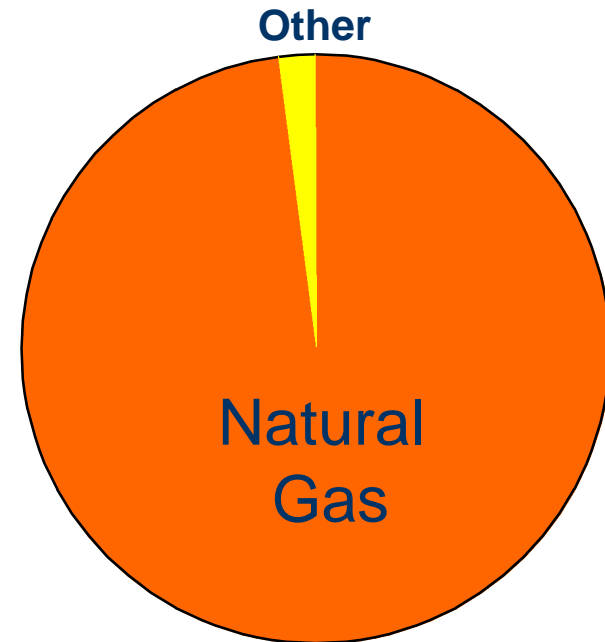
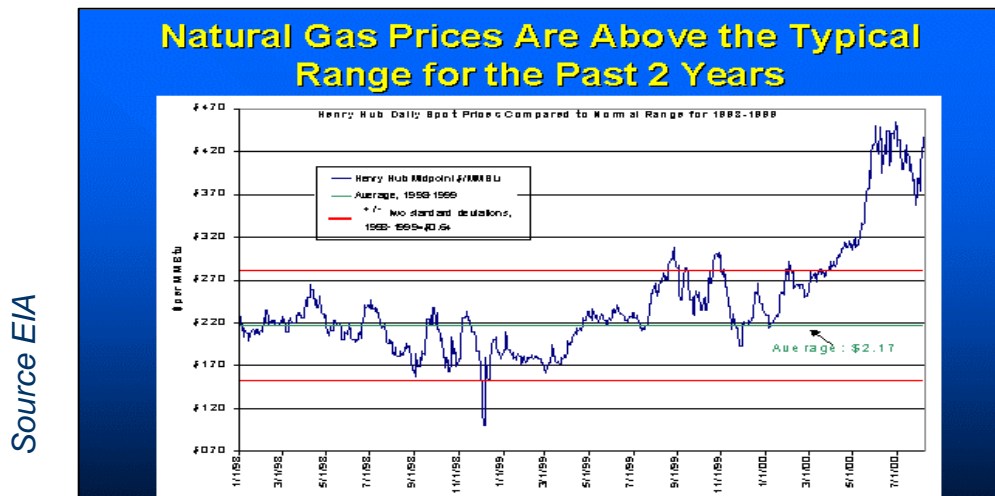
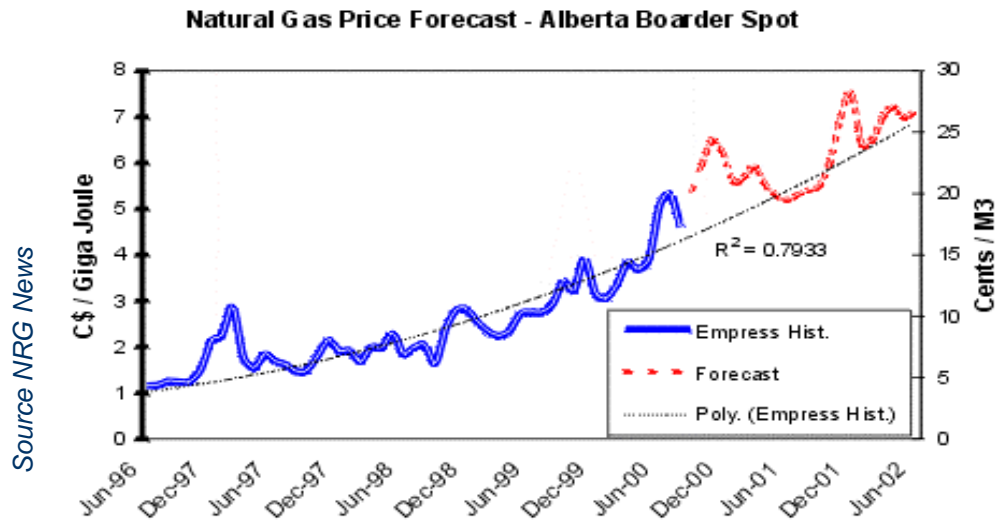
Capacity Margins Diminishing



Source: National Energy Reliability Council,
Reliability Assessment 1999-2008,
ftp://www.nerc.com/pub/sys/all_updl/docs/pubs/99ras.pdf

.....Driving into a wall?

Herig, Perez & Letendre, UPEX-2000



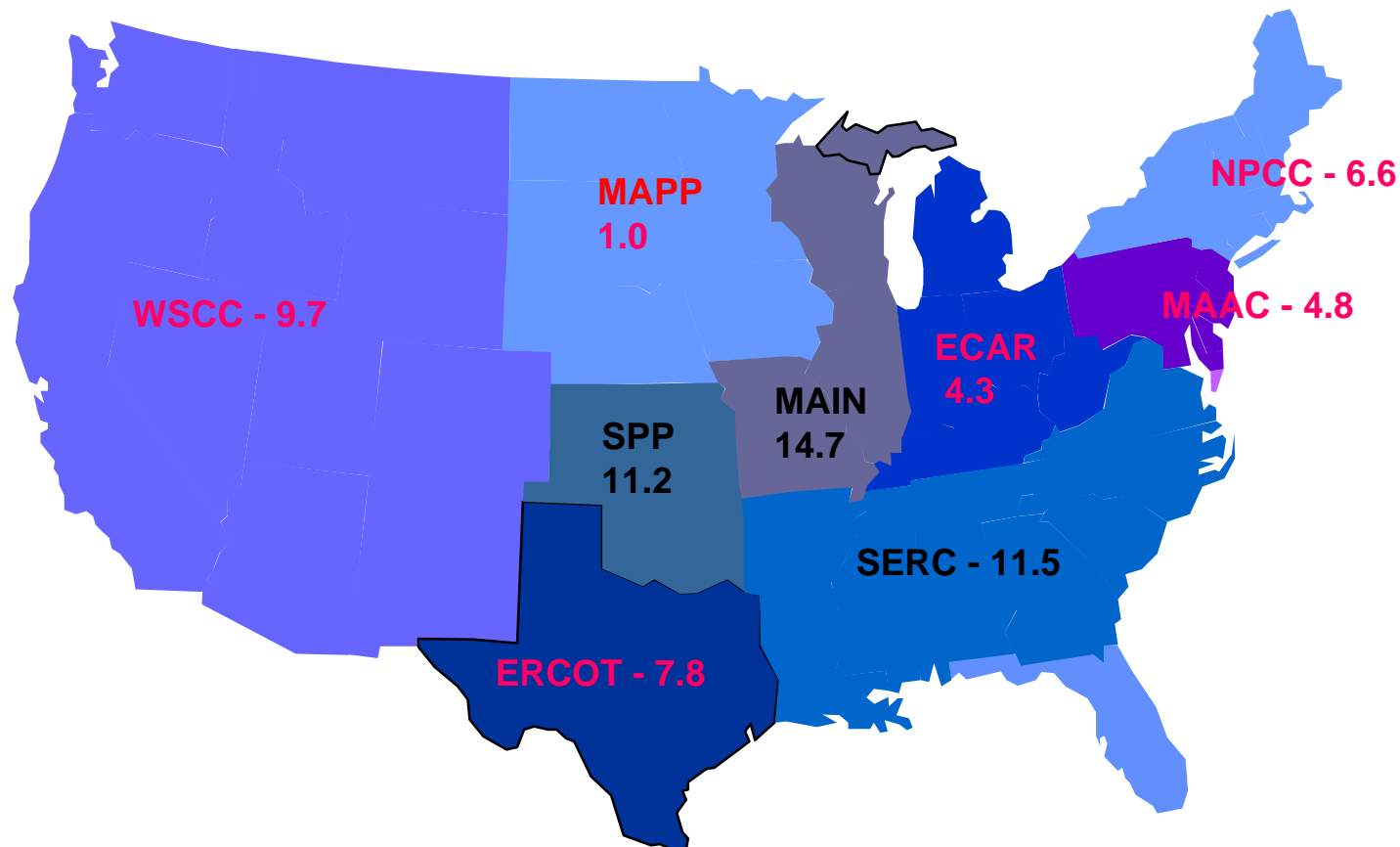
Planned New
Generating Capacity
In the USA

Source S.Taub, CRA



Forecasted Regional Capacity Margins

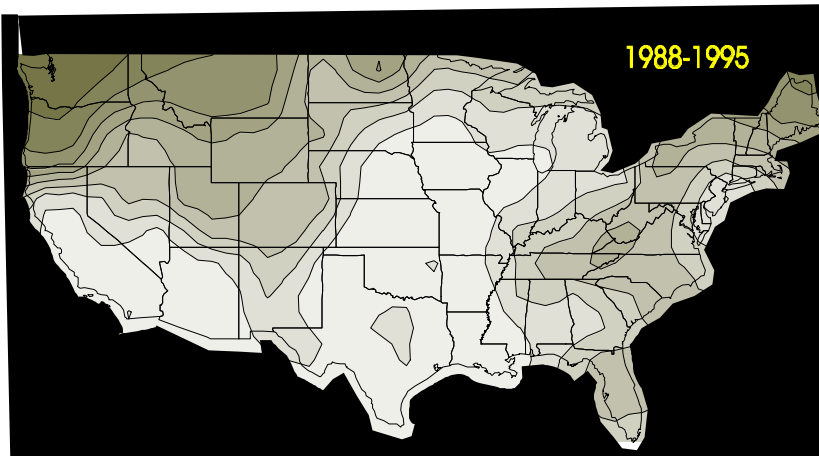
2008 Summer



Source: National Energy Reliability Council,
Reliability Assessment 1999-2008,
ftp://www.nerc.com/pub/sys/all_updl/docs/pubs/99ras.pdf

PV Has Capacity Value

Utility-Wide PV Effective Capacity



End-Use PV Effective Capacity

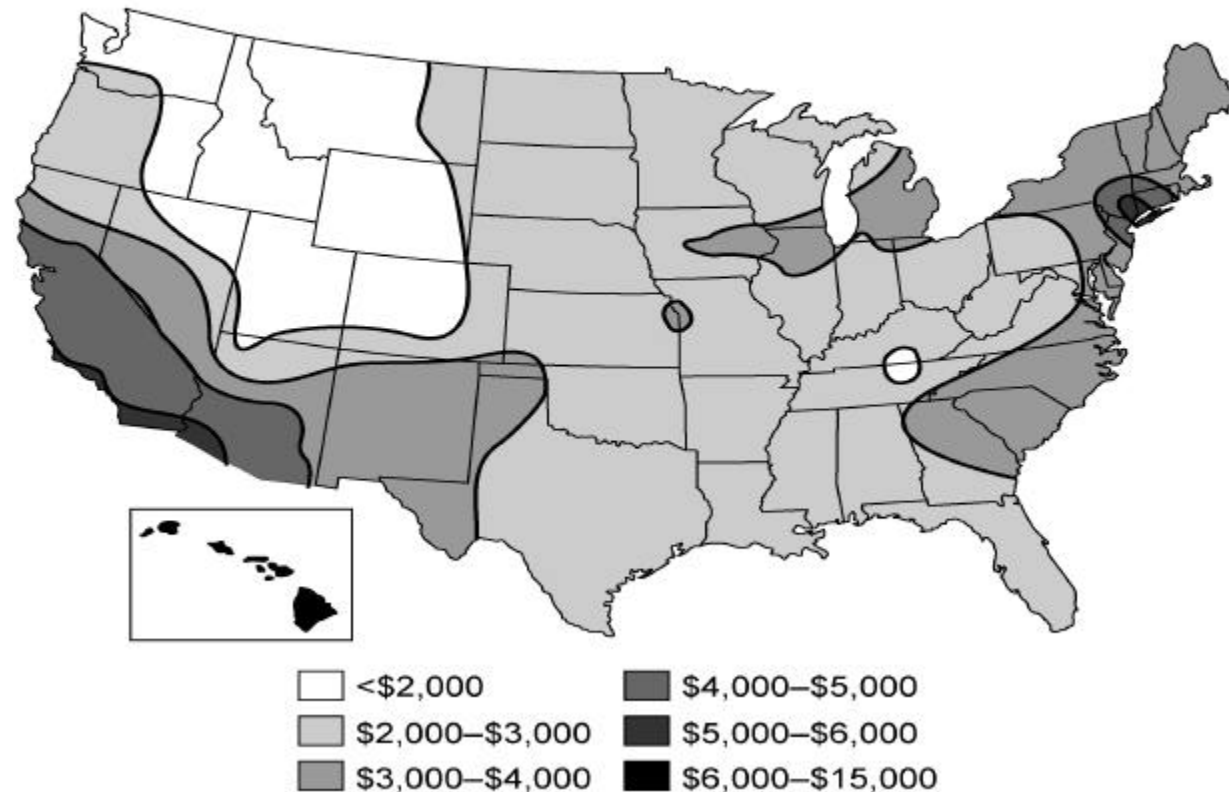
	Average ELCC (%)	Standard Deviation (%)
Offices (no electric heat)	66%	0.12
Residences	39%	0.39
Hospitals	63%	0.11
Airports	33%	0.13
Offices (electric heat)	30%	0.05

Capacity and Energy

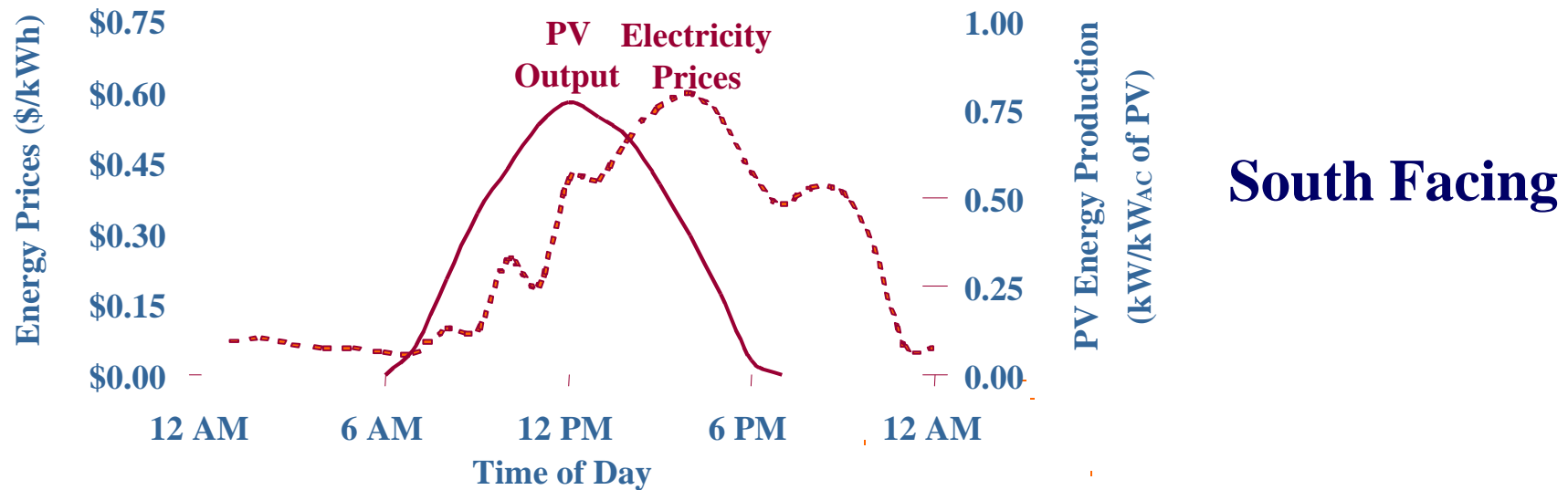
Using Small Commercial TOU Tariffs

Break-Even Turnkey Cost (BTC) per Kilowatt

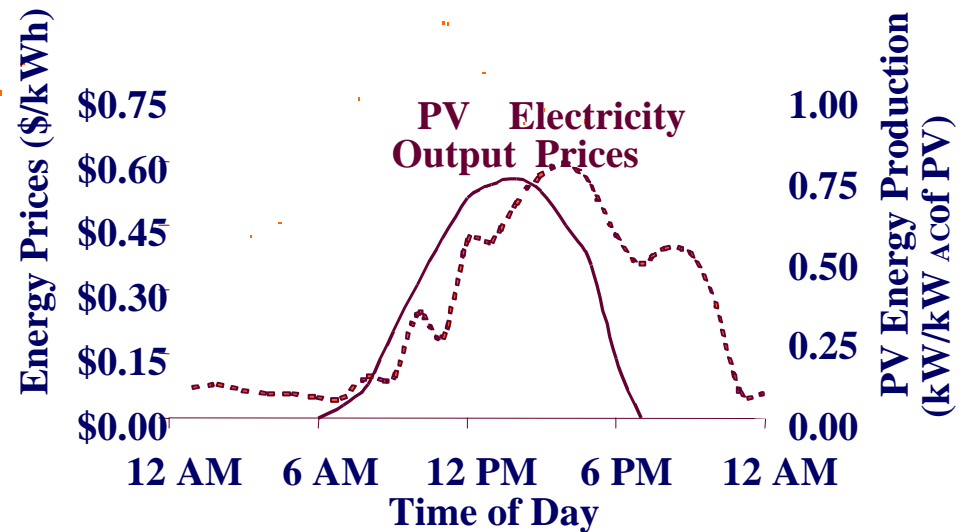
These figures are based on a two-axis tracking PV system. A fixed-tilt PV system reduces the BTC by roughly \$1000/kW at the high end and \$500/kW at the low end.



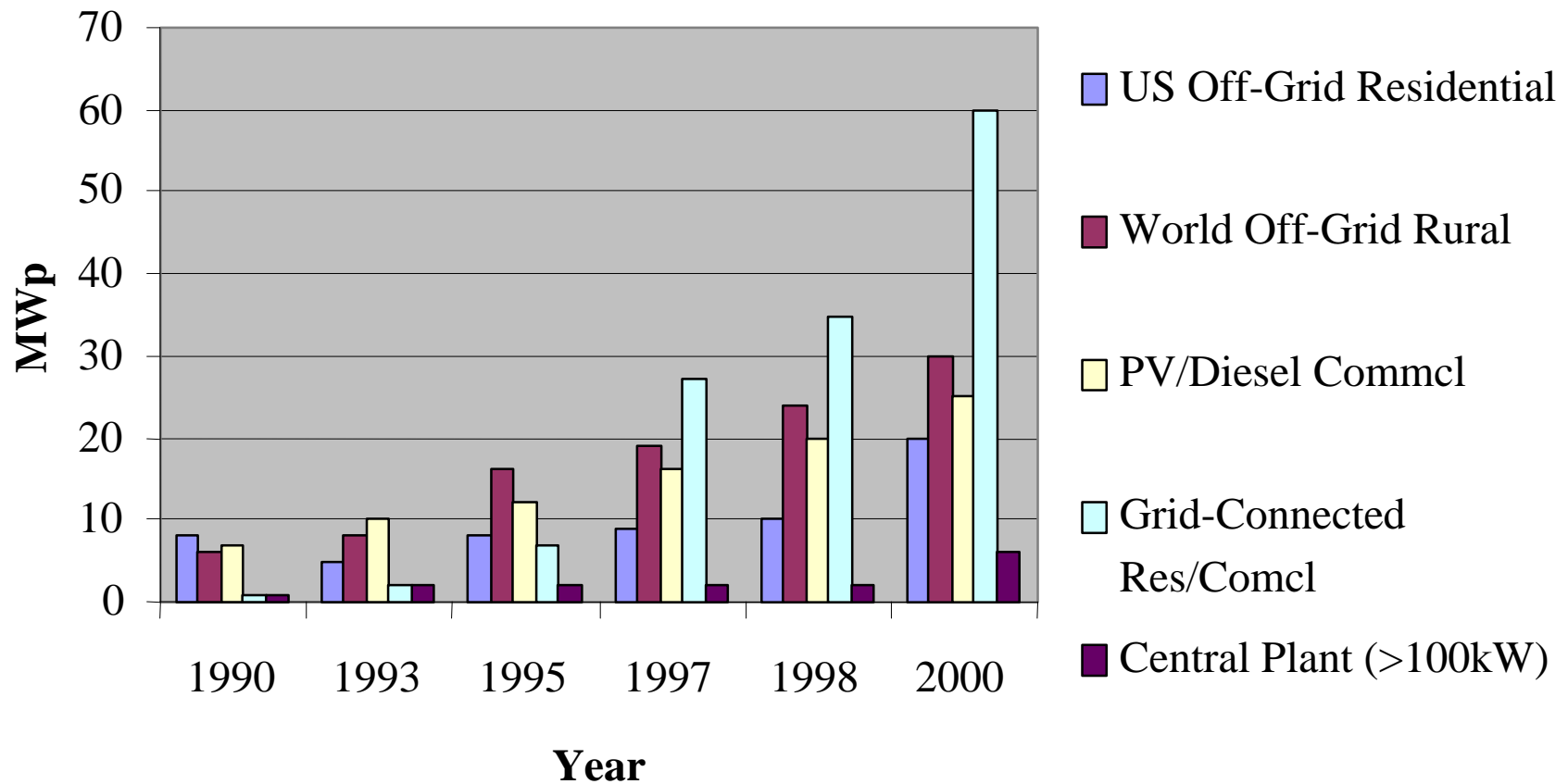
There are Profile Control Options



West Facing

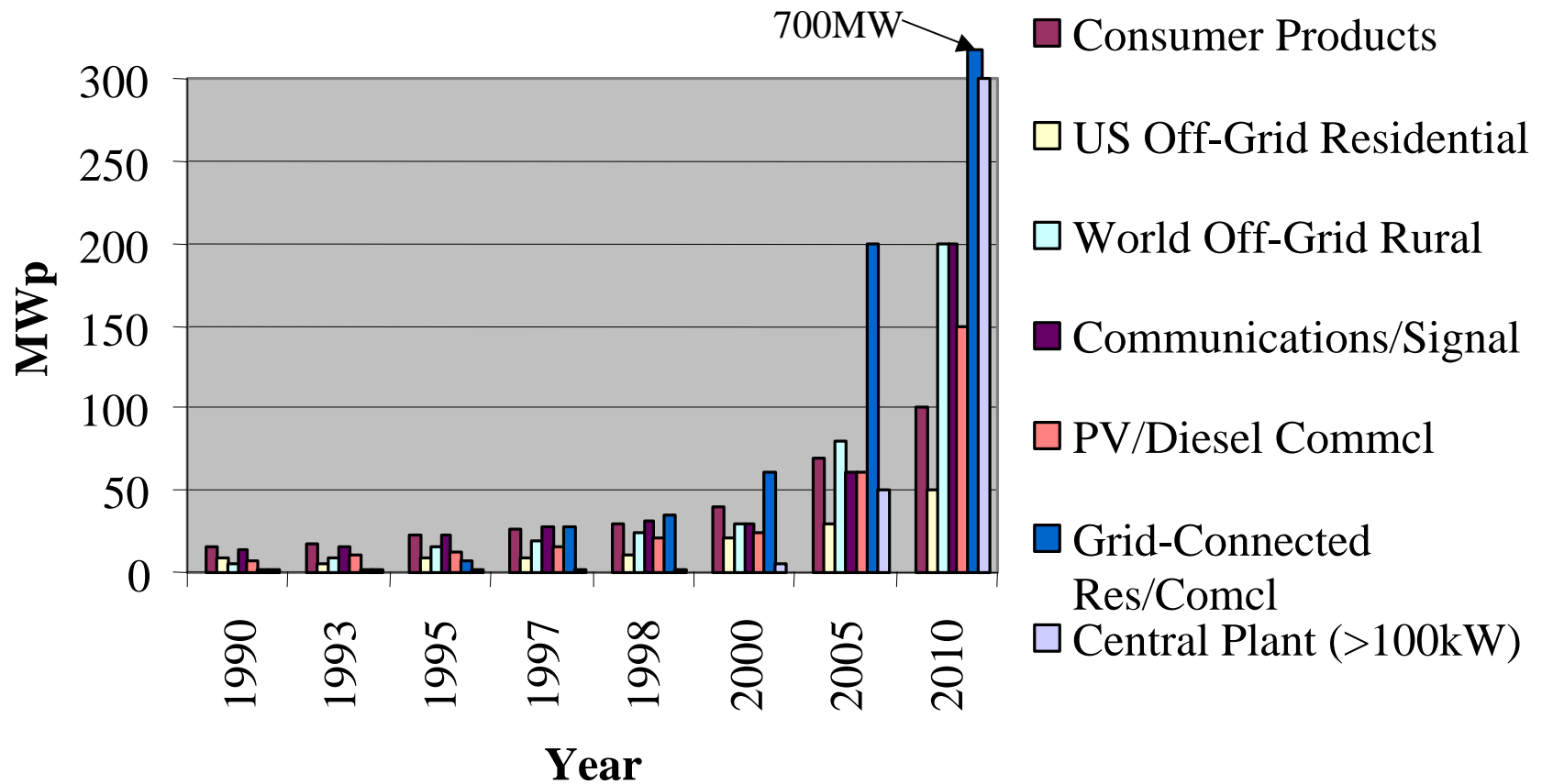


PV Market Actual



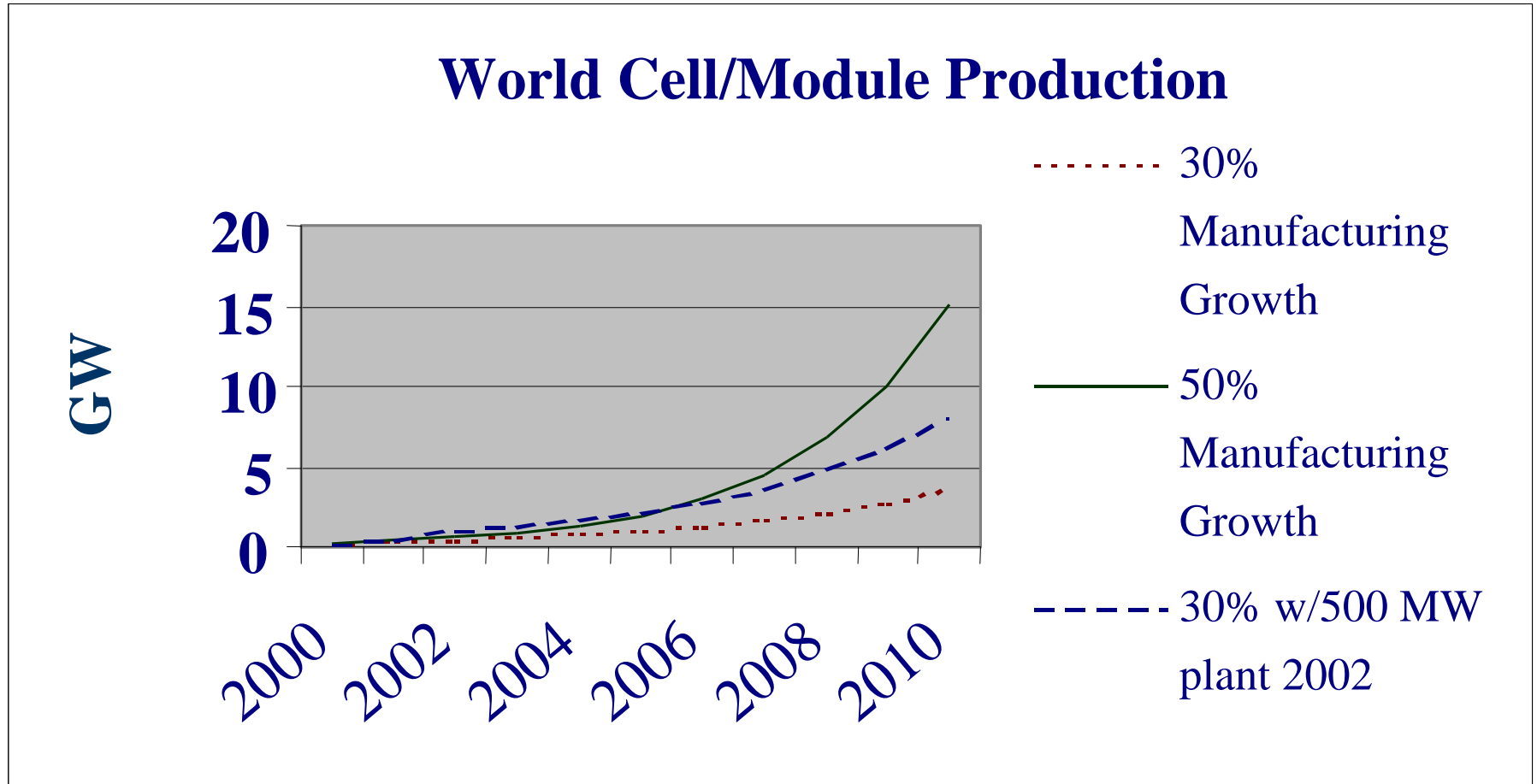
Source: PV Technology, Performance, Manufacturing cost & Markets:Forecast to 2010, Paul Maycock

PV Market (Actual /Forecast)



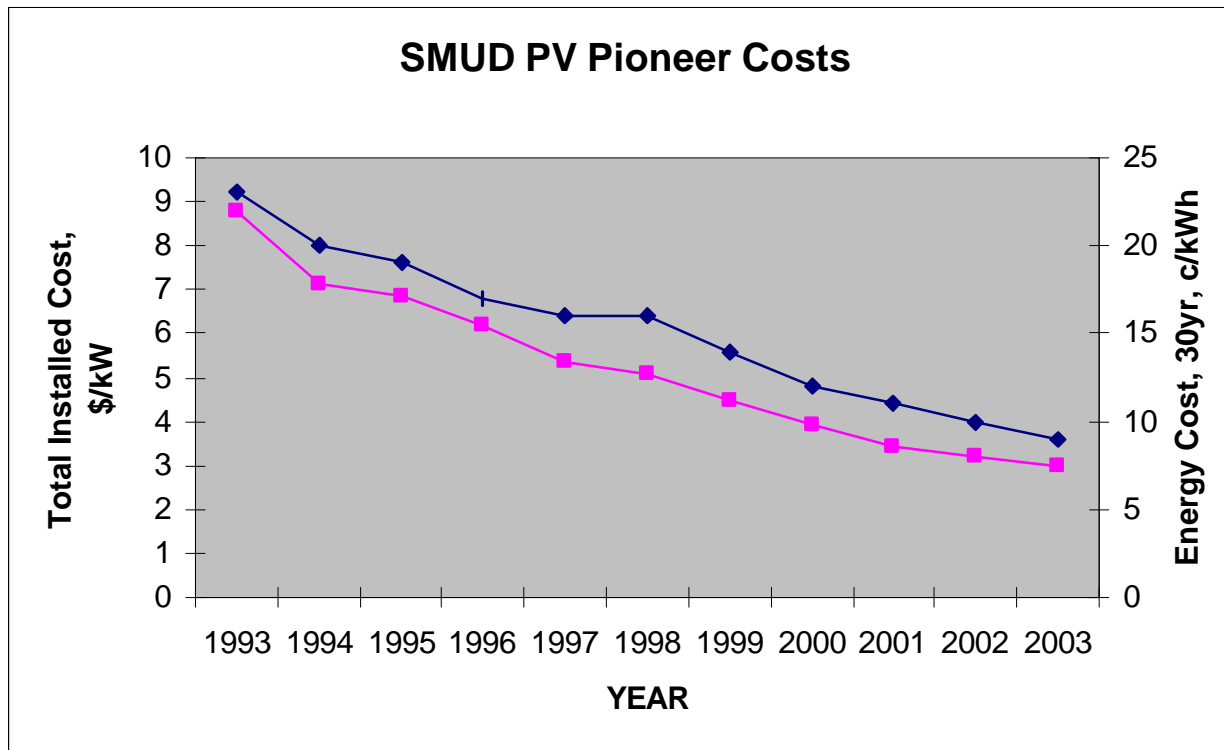
Source: PV Technology, Performance, Manufacturing cost & Markets:Forecast to 2010, Paul Maycock

PV Product Supply



Source for baseline: PV Technology, Performance, Manufacturing cost & Markets: Forecast to 2010, Paul Maycock

Volume Purchase w/Time Commitments



Is There a Business Opportunity for Energy Service Providers?

Consumer's average levelized cost of
Uninterruptible Power Supply

40¢/kWh

Add PV modules

10¢/kWh

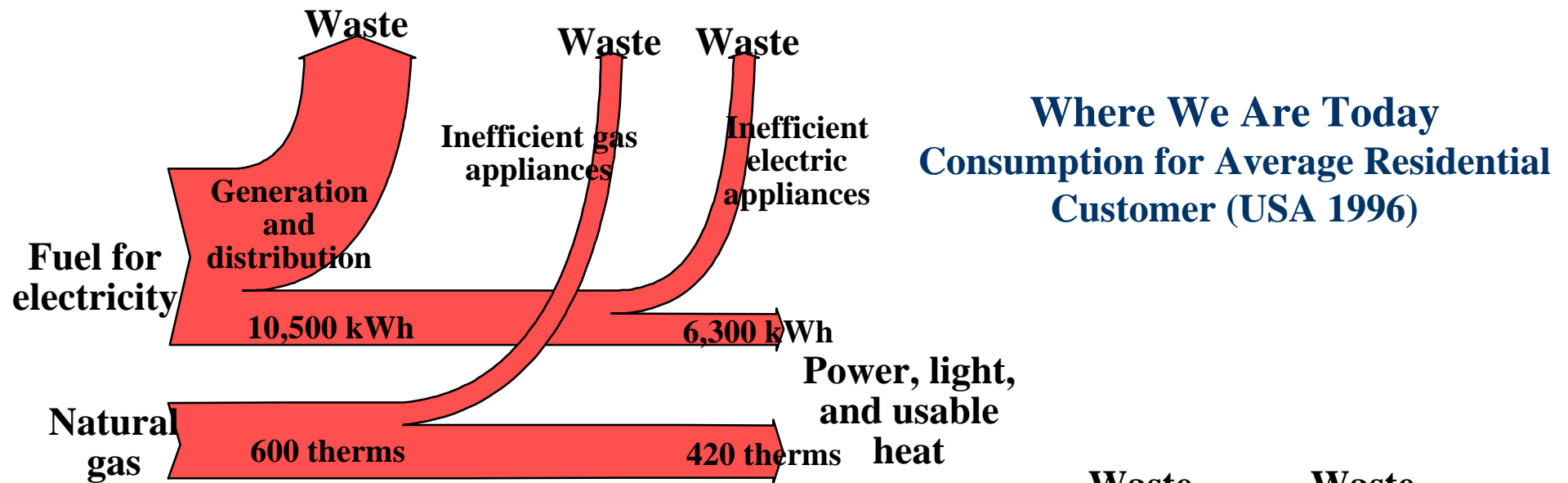
Retail value

50¢/kWh

Utility costs and benefits during summer mid-day peaks?

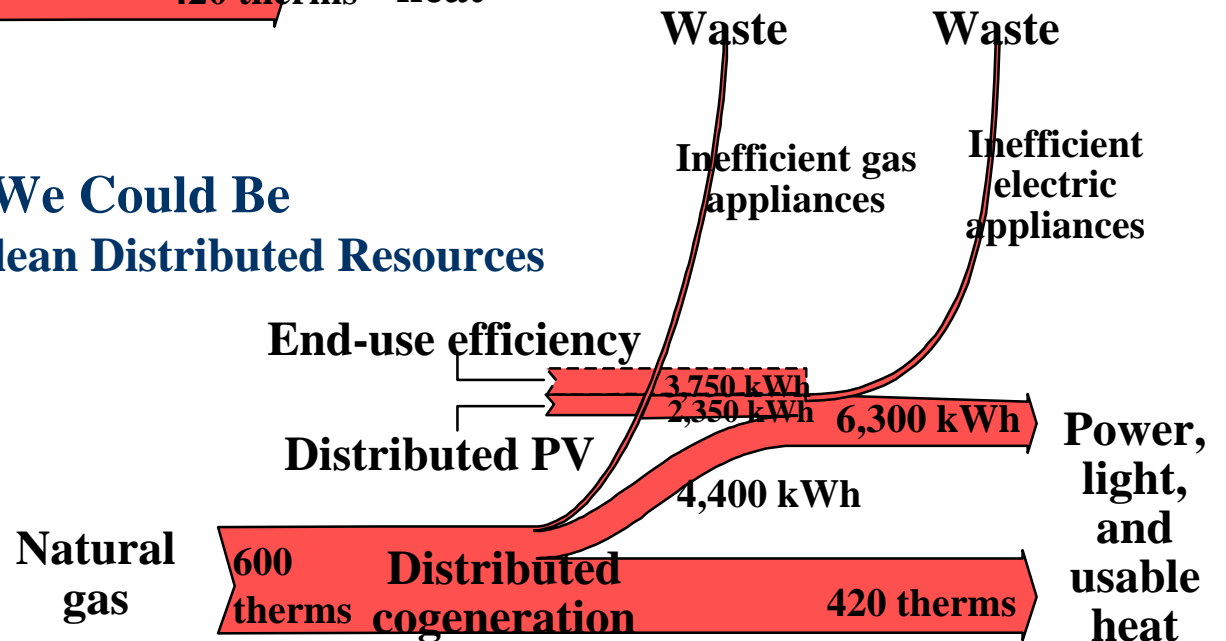


Technology Alignment is the Key



Where We Could Be

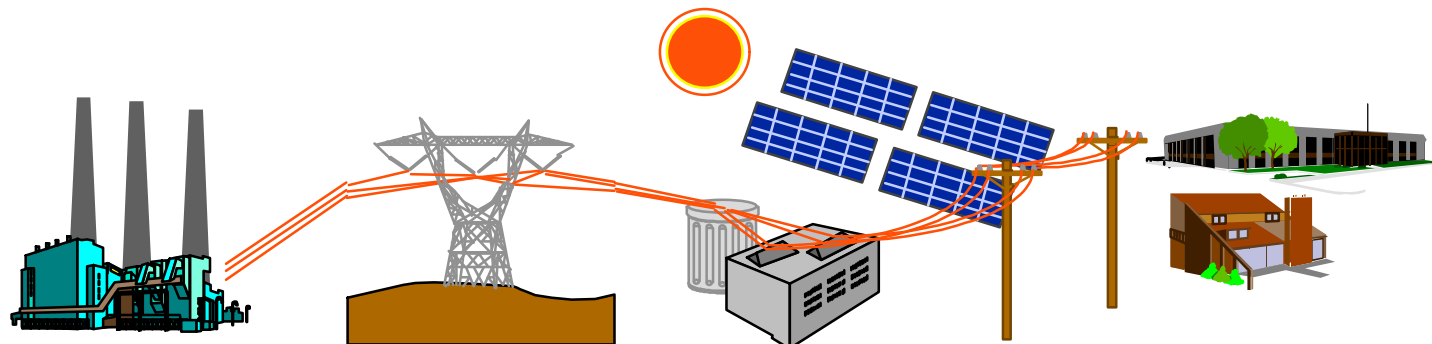
Consumption with Clean Distributed Resources



Beta Version

QuickScreen

A Distributed Resource Planning Tool



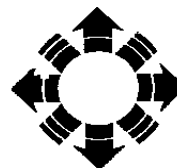
Start

Exit

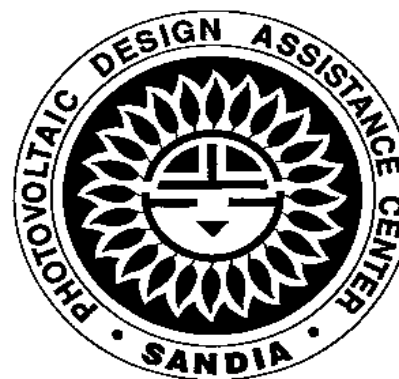
?



Pacific
Energy
Group

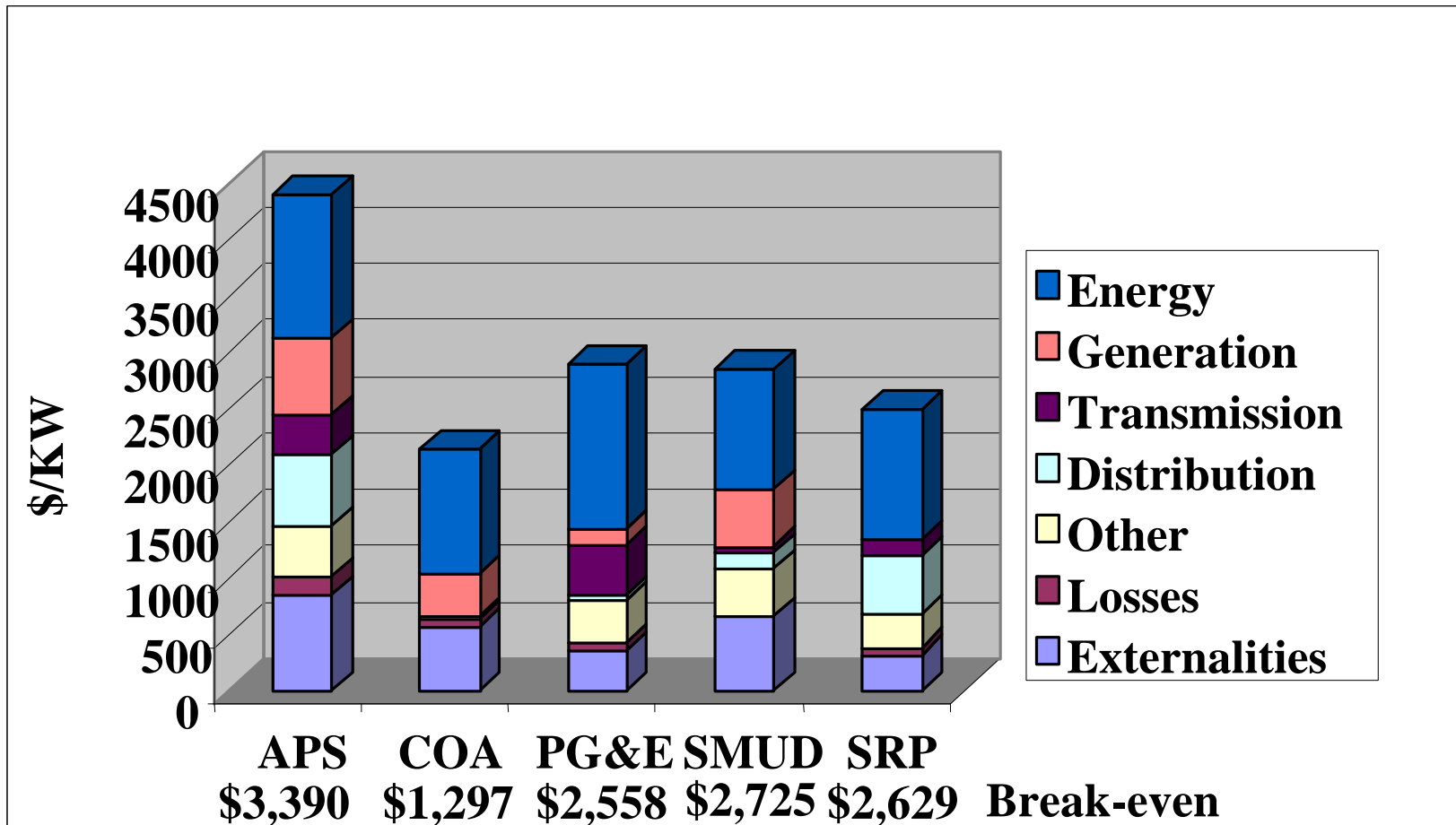


NREL



Download at: www.PacificEnergy.com

Utility DG Benefits



High Value Applications

- T & D constraints
- Rural, low customer density, old grid infrastructure
- Urban, underground, high customer density, built-out
- Remote, difficult T&D access or maintenance
- Low load growth



Conclusions

- Value depends on the benefits exploited
- Technology/industry alignment is the key
- Policy can join the value streams of varying ownership scenarios
- In the short term PV is a customer solution (DSM), but with sustained orderly development?????

Reports on Risk and Microgrids may be obtained off the web at <http://www.clean-energy.com>

QuickScreen software may be obtained at <http://www.pacificenergy.com>



Next Steps

- Least Cost or IRP for the TDU, DisCo, ??
 - G,T&D deferral, energy, demand, line loss
 - Ancillary services
 - Voltage support
 - Option value (lead time)
 - Size flexibility
 - Location flexibility
 - Fuel diversity
 - Environmental value
- Regulators/State,Regional&Local Governments Beyond Deregulation?
 - Essential Energy Services
 - Infrastructure Planning for Growth Management and Economic Development



Modularity/Versatility/Mobility



Expensive Low Energy Services

Building Integrated Products

